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solplan review

the independent journal of energy conservation, building science & construction practice

Inside . . .

Water conservation is becoming a big issue, as urban areas expand and we run out of easily exploited sources. R-2000 will be starting to call for water conserving fixtures. We present information on low flush toilets that are already on the market, and some alternatives.

Building with the environment in mind requires considering a lot of issues. CHBA-BC has developed a Builder's Environmental Checklist. We present a portion of it. We also report on the Build Green product labelling program being developed in Toronto.

The National Building Code will be undergoing major changes. We highlight a few of the most significant changes being proposed. There's still time to make comments.

Other items include TRC news, a book review, letter to the editor, and more.

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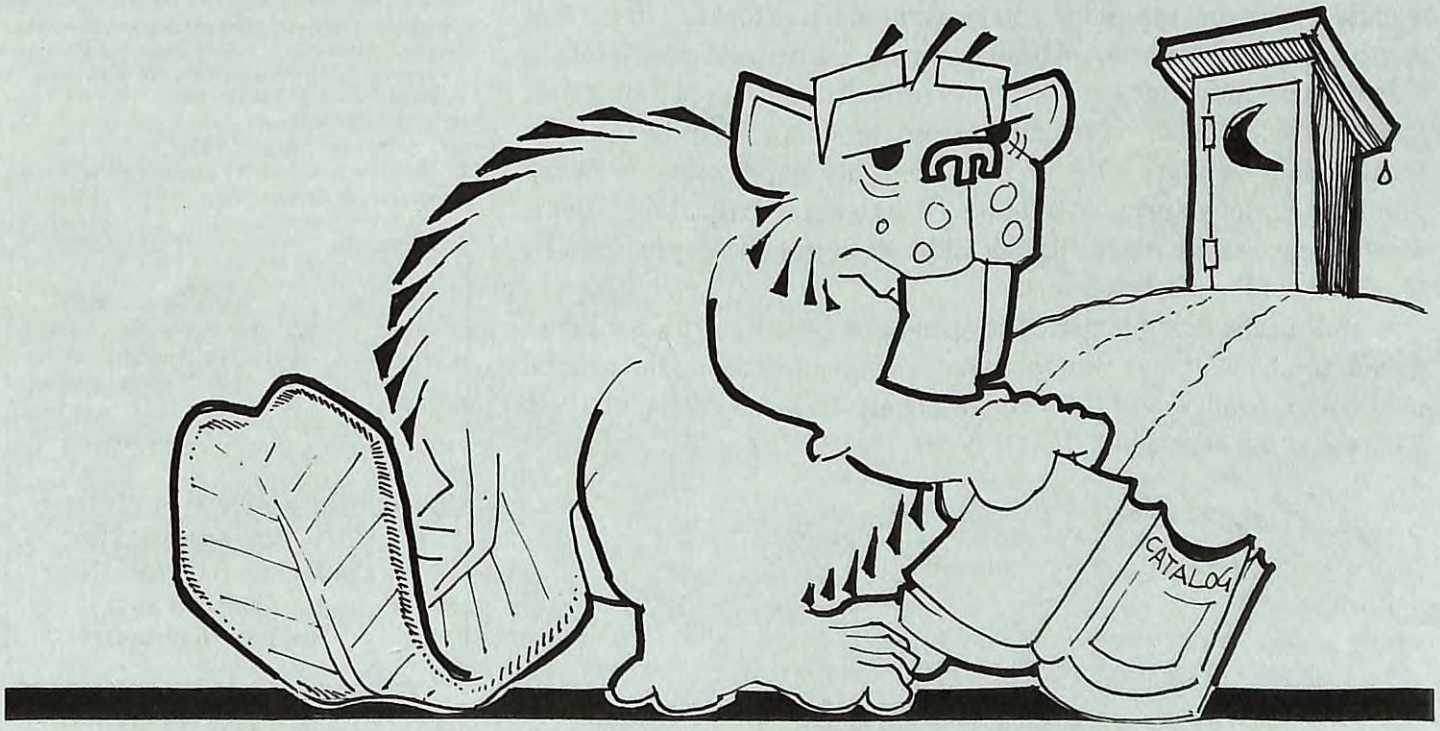
Water Conservation



From the Editor . . .

We are, without a doubt, among the best housed people in the world. We constantly tell ourselves about the better quality home that we build today. But are we kidding ourselves? Have we talked ourselves into believing what we want? Is there no room to improve? Can we sit back and relax on our laurels?

Our houses certainly are bigger than they used to be. Per capita we probably use more finished space than anybody else. But is large size a mark of better quality? If we look around a typical new home today, there are many items that raise doubts about the quality of what we build. A lot of the effort goes into the surface *look* of fixtures, cabinets, or whatever, and not into the more substantial concerns that ensure long life.

When you buy a tool or truck, do you buy it because it looks good, or because it is easy to use, does it's job, is durable and well put together, to ensure a long service life? Shouldn't we be making sure the same thing goes for the products we build?

I realize than it's not all the builders' fault, because you can only do so much with the tools you have to work with - and here I mean the manufactured components you use. Surely industry can start improving their products, whether it's making an efficient, quiet fan for the ventilation system, a better furnace blower, or better hardware.

I am constantly surprised at the lack of quality control on products that manufacturers ship out. What good is an impressive looking finish that is only skin deep, made out of third rate materials that will deteriorate in a short time? Sometimes, it's so poorly made it doesn't even look good!

But if we are to see more better quality products, we must insist on them. Manufacturers must be persuaded that sloppy, shoddy cheap products are not good enough. I know it may not be easy at first, but if enough requests are made, they should start to respond - at least that's the theory of the marketplace.

It also means being prepared to spend that little bit extra for better quality products. It may well mean more effort at educating the general public what quality means. It may mean only 2½ baths instead of 3½ to keep the home accessible!

Richard Kadulski,
Editor

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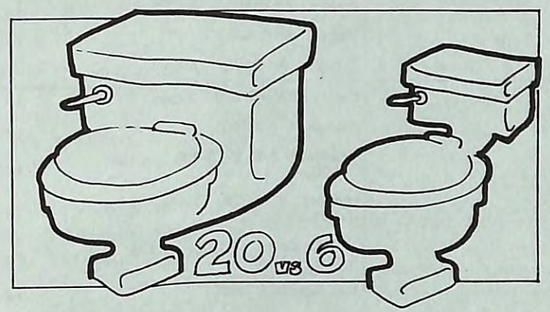
Water Conservation

It may seem strange to be concerned about water conservation in Canada with its abundant water supplies. Our water rates are among the lowest in the world, while consumption is the highest. However, as developers are aware, the availability of supply and delivery infrastructure to provide more is questionable in most urban areas. As a result water conservation is being recommended everywhere and in some areas mandated.

An average family of four uses more than 1,000 litres of water a day. Toilets consume about 40% of that. Based on an average four flushes per day for each person, the saving in water charges alone from switching form a traditional 19-litre toilet to a six-litre toilet could be about $35.00 a year. Some municipalities add sewer surcharges based on total water consumption. In Ottawa, for example, annual water savings would amount to about $90.00.

Massachusetts passed the first North American water conserving law in 1989. Since then 12 U.S. states and many cities have followed specifying six-litre toilets for new homes or renovations. In parts of California homeowners are required to show proof that their home is equipped with six-litre toilets before closing a sale.

Drought is a major reason for the development of strict water conservation regulations in many states south of the border. In others, overburdened sewage removal and water treatment facilities are the dominant factors. Water conserving legislation will become as widespread in Canada as it is in the USA. Many Canadian cities have already drafted, or are in the process of drafting, legislation to address similar issues.



Vancouver is facing the need to upgrade its water system so it is likely that legislation to control water usage in new developments will be in place soon. A number of Alberta municipalities, including Edmonton, are exploring appropriate legislation and building code changes to meet similar concerns.

In Ontario 13.25-litre toilets and low flow fittings are already required by code for new home construction or renovation. By January 1, 1996, six-litre toilets will be mandatory.

The B.C. Ministry of Municipal Affairs has received many requests to immediately implement changes to the Plumbing Code to mandate water conserving fittings and fixtures. Presently they are not regulated by the B.C. Plumbing Code as there is no easy way for local enforcement officials to determine what kind of fixture it may be.

On Oct. 15 the B.C. Ministry issued a memo indicating they will move slowly before requiring water conserving fixtures. The proposed first step (some time in 1994) will make provision for reduced flow faucets and shower heads and possibly more efficient water closets (watersaver type at 13.25 litres (3 gal) per flush cycle). Greater flow rate reductions (to low consumption toilets with 6 litres (1.3 gal) per flush cycle) might be implemented in 1996.

Annual Water Usage by Toilet Type

(litres/year)

Toilet Type	Water consumption per flush (litres/flush)	Water consumption (average 4 person household) litres/year
Conventional	20	116,800
Water Saver	13.25	77,380
Ultra low flush	6	35,040

Water Conserving Toilets

Manufacturer	Model	Water Use (litres/flush	Features
American Standard	Cadet III AF-2660, AF-2650	13.25	
	Fontaine AF-2006L, 2007L	13.25	
	Plaza AF-2001L	13.25	
	Plebe AF-2601	13.25	
	Ensign AF-2193, AF-2191	6	
Crane	Baby Bowl 3-210, 3-380	13.25	
	Chequers 3-100	13.25	
	Cranada 3-193, 3-194, 3-197, 3-198	13.25	
	Hymont II 3-338, 3-174, 3-175, 3-701	13.25	
	Neu-Chateau 3-142, 3-146, 3-148, 3-149	13.25	
	Neu-Saneto 3-297	13.25	
	Radcliffe 3-183, 3-185, 3-253, 3-254	13.25	
	Radcliffe II 3-230, 3-231	13.25	
	Accent 3-121	6	Not CSA certified
	Cranada ULF 3-413, 3-414	6	
	Magnum 3-118	6	
	Radcliffe ULF 3-401, 3-402	6	
Eljer	Laguna	6	Two tank units use a mix & match bowl and tank arrangement, so that an individualized look can be achieved by the combination of tank & bowls selected.
	New Preserver II	6	
	Patriot 1.6	6	
	St. Clair	6	
	Emblem Ultra Saver	6	
	Terrace Ultra 1.5G	6	
	Triangle Ultra 1.5G	6	Triangular tank ideally suited for a corner installation
	Ultra 1.5G	6	
	Berkeley	6	
	Savoy	6	
	Preserver I	6	
IFO	Cascade	6	
Kohler	San Raphael Lite K-3394	6	Pressure clean flushing system
	Rialto Lite K-3404	6	Pressure clean flushing system
	Portrait Lite K-3490	6	gravity fed flushing
	Couture Lite K-3471	6	gravity fed flushing
	Wellworth Lite K-3420, K-3421	6	gravity fed flushing
Alascan	Nepon Pearl	1 cup	foam flushing toilet part of composting system. Requires 120V AC power hook-up to initiate foaming flushing action
Ventex	Ventex	13.25	Odour removing toilet, draws air directly from the bowl through the tank, venting through a 2" pipe to the exterior.

The reason for moving slowly is that, according to the B.C. Ministry, there exists an availability problem for water conserving water closets at the present time. It seems that unlike other parts of North America low consumption type water closets are presently not available in sufficient quantities to meet the needs of the British Columbia housing marketplace.

Why B.C., with limited production facilities, should have an availability problem, while other jurisdictions don't, is not explained by the Ministry.

What are the Current Standards?

For water closets, CSA Standard CAN/CSA-B45, "CSA Standards on Plumbing Fixture", covers the conventional type which consumes approximately 22.75 L (5 gal) per flush and the watersaver type which uses 13.25 L (3 gal) or less per flush. Recently low consumption type water closets that consume no more than 6 L (1.3 gal) per flushing cycle were added to the CSA standard.

Performance standards for low consumption type water closets are still being reviewed by the CSA. Because of the impending NAFTA agreement between the United States, Canada and Mexico standards writers in the three countries are working towards similar performance requirements (i.e. harmonizing) for plumbing fixtures, including for water closets.

The major issue is the labelling requirements. Currently there are no CSA marking requirements to distinguish water conservation water closets, faucets and shower heads from the conventional types. Canadian manufacturers have agreed to mark water conserving fittings and fixtures by August 1994 with a label that identifies the flow rate.

Some manufacturers have developed their own special logo to promote their Water Conserving products. American-Standard has a logo that features a water droplet with two waves to the left and one wave to the right signifying water conservation.

Categories and Water Consumption of Toilets	
Low Consumption (Ultra Low Flush or ULF)	6.0 litres/flush or less (1.3 Cdn gal/1.6 US Gal)
Water Saver (Water economy)	13.25 litres per flush or less (2.9 Cdn gal/3.5 US Gal)
Conventional	more than 13.25 litres per flush (more than 2.9 Cdn gal/3.5 US Gal)

Another concern about toilet performance is how will they work (in technical jargon: are there skid marks left on the bowl after flushing?).

In addition to conventional gravity fed operation, most manufacturers have modified the operation - some by using a larger trapway, others use compressed air or water pressure to provide a force full flush with little water.

The industry uses a "ball pass" test - which measures how big a ball will pass through the toilet. Crane's very low flush toilet has a 2" trap way while American Standards' units have 1 - 7/8" diameter.

Kohler has one and two piece models that use incoming water line pressure to compress the air in a reservoir within the tank. When the toilet is flushed, the compressed air within the reservoir propels water to the siphon jet bowl for positive flushing action. A minimum water supply of 25 psi is required. System components are preset at the factory with no adjustment necessary for easy installation.

A more high-tech approach by Kohler is their Power Lite operating system which utilizes a Twin Touch™ actuator to offer a choice of 4 litres or 6 litres of water with each flush. The key to this flushing system is a factory-installed .2hp pump that propels water from the toilet tank directly to the rim and siphon jet for complete bowl flushing, even with water pressures as low as 20 psi. To power the pump, the toilet must be plugged into a standard GFCI electrical outlet.

R-2000 Technical Requirements

As part of the shift to incorporate environmentally responsible construction practices, the proposed revisions to the technical standards will require that water conserving toilets be installed in all new R-2000 homes. The standard calls for at least 13.25 litres (or less) per flush.

There have been concerns about the availability of suitable equipment. Any of the units listed on the accompanying table would meet the proposed standards. Builders in Ontario, of course, will not have any supply problems as these are the only units permitted by the Ontario code.

Composting Toilets and Greywater systems

Disposing of human wastes is a concern because of health considerations. This is especially an issue in areas where water supplies are scarce or soil absorption is limited. A wide range of strategies are used - from using an open air field to the tried and true outhouses to composting toilets.

Biological toilet systems all work on similar principles as large scale municipal systems, but because of health concerns they must be considered with care.

A biological toilet/greywater treatment system was first proposed for year-round use in the "Codicile", the winning Toronto house for CMHC's Healthy Housing Design Competition last year.

Biological toilets have a role to play in the solution of seasonal, on-site waste disposal problems. At the present time, the year-round use of biological toilet systems is limited to those situations where water supplies are scarce or soil absorption is limited. The exceptions are those environmentally conscious owners who are willing to accept the aesthetics and costs involved.

Improved designs tend to be more expensive and more complex, which tempers the original appeal of biological toilets for household use, which was their low cost and simplicity.

Biological toilets were introduced to North America in the early 1970's from Scandinavia, where they had been largely used seasonally. Concerns about aggressive marketing for year-round use led authorities in Scandinavia and North America to require testing and certification. By the early 1980's the number of competing devices was dramatically reduced.

Independent third party testing showed that many units were not true composting units, as they did not achieve the high internal temperatures associated with

Goodbye to the Flush Toilet

composting. They are better described as biological toilets, operating under aerobic conditions to achieve waste degradation and liquid loss through evaporation.

What is a Biological Toilet?

A biological toilet is a system which accepts feces, urine, toilet paper, and in the large systems organic kitchen wastes, eliminates excess liquid through evaporation and drainage and aerobically decomposes the solid material. (The overall solid content of human body wastes its less than 10%.)

A biological toilet does not truly "compost" because the heat loss from evaporation through venting is too great to reach the high (lethal) temperatures characteristic of true composting. Actual temperatures reached in a large biological toilet are only minimally above ambient conditions. In some installations, especially in the north, they may need extra heat.

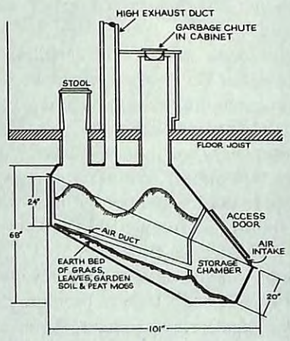
The carbon and nitrogen ratio of human body wastes needs to be supplemented by the addition of kitchen or garden wastes to avoid over-production of ammonia which can be offensive to users, and numerous creatures in the treatment tank which may climb up the chute to the toilet seat to escape the ammonia toxicity.

There are two basic types of certified biological toilets commercially available in Canada. Each stabilizes human excrement with or without separated household garbage by aerobic decomposition in an enclosed chamber. The liquid is evaporated and moisture exhausted through the vent pipe. Start-up requires priming the chamber with readily decomposable material, and occasionally adding extra quantities.

Large unit are designed for year-round use. They have a large capacity, few moving parts and are separated from the toilet. Small units sit in the bathroom with the toilet seat on top of the treatment tank. This type of toilet utilizes electrical heating coils, forced ventilation, and mixing devices to promote rapid aerobic decomposition and evaporation.

Large, Inclined Separated Floor Type

This type was first introduced in the late 1930's as the *Clivus-Multrum* in Sweden. The design is based on the realization that the combination of human excreta with organic kitchen or garden



wastes under conditions of extreme aeration will result, with time, in an acceptable compost.

These large toilets rely on receiving the kitchen garbage wastes in addition to the toilet wastes. The advantages of large biological toilets are that human and organic kitchen wastes are treated; there are fewer removals of end-products; there is better buffering against shock loadings and lower operational and maintenance costs.

The disadvantages are: higher capital costs; in cold environments an external heater may be necessary to maintain desired temperatures; the large unit requires two floors leading to critical design and installation is problems, proper vent installation critical to satisfactory operation; starter material is required at the beginning of operation and periodically afterwards; overloading with liquid wastes is critical; there are possible problems with flies at the beginning of operation, and both liquid and solid end-products have to be removed and disposed of as required.

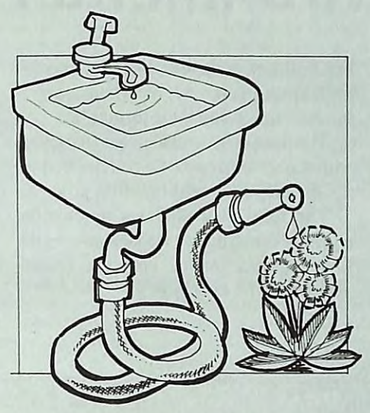
The small units use electrical heating coils and forced ventilation to promote rapid aerobic decomposition and evaporation. They have a small decomposition chamber attached directly to the toilet seat. The necessary humidity and temperature conditions are maintained by the electric and mechanical devices in the toilet.

The installed power capacities vary between 130 and 500 watts.

The advantages are small size, lower purchase price and modest electrical power consumption, and they are easily adapted to conventional home designs.

The major problems include: sensitivity to hydraulic overloading, insufficient mass to sustain composting process, objectionable anaerobic odours, mechanical and electrical failures.

Biological toilets cannot accommodate greywater - all the household waste water: the waste water from the kitchen



sink, lavatories, showers, bathtub, washing machine and dishwasher. An approved greywater system must accompany a biological toilet installation. The design, technical feasibility, and economics of available greywater treatment systems have yet to be proven and generally accepted. A number of the Advanced Houses built across the country are investigating the feasibility of recovering the heat contained in grey water.

Scandinavian authorities initiated a testing program which led to the development in 1981 of a standardized testing procedure for the approval of composting devices for either vacation or permanent homes. In the USA, the National Sanitation Foundation (NSF), an independent, not profit testing organization, adopted its Standard 41 for Wastewater Recycle/ Reuse and Water Conservation Devices.

Greywater must be treated and disposed of in a sanitary manner and not be allowed to drain on top of the ground or be placed in a simple, soak-away pit without treatment. At present, most biological toilet owners have to treat greywater in a septic tank with a conventional tile field, although some jurisdictions permit a reduced size for the greywater tile field.

Where soil conditions prevent liquid waste systems from operating in a conventional manner, the biological toilet may provide a partial solution to the disposal problem. Means to handle the remaining greywater must be found.

For northern locations, the major advantage of a composting toilet is the elimination of flushing water, as the supply and storage of potable water with the subsequent disposal of wastewater are very costly.

Potential Applications for biological toilets and greywater systems include: vacation homes; remote recreational properties; cottages; remote residences; new energy-saving homes; and basement remodelling.

Summarized from "Biological Toilets and Greywater Systems" Prepared for: Research Division Canada Mortgage and Housing Corporation National Office
By: A.R. Townshend, P. Eng.

Maple Leaf Award

Every year at its annual convention the Canadian Home Builders' Association of B.C. recognizes the outstanding contributions of some members by presenting the Beaver award to its Builder Member of the Year, and the Maple Leaf Award to "*the Outstanding Non-Builder Member of the Canadian Home Builders' Association of British Columbia* ".
This year the Maple Leaf Award was presented to your humble editor, Richard Kadulski.
What can I say, but ah shucks! Thanks for the recognition. RK

Builders' Environmental Check List

Increasingly, the process of development and construction can become a tangle of red tape. Concerns for the environment are making an extended process even more complex. To help their members CHBA-BC has developed a builders environmental check list.

This check list is designed to lead a builder or developer through the many environmental considerations and issues which may come into play when designing, building or developing land. It covers many aspects yet is brief and concise in providing relevant information.

The document will alert you to issues which may otherwise be overlooked in the development and building process.

The form also includes renovation and new construction waste audit charts to help plan a project. This is an edited version of the checklist.

	DESIGN CONSIDERATIONS	
	TOPSOIL MANAGEMENT Many municipalities have topsoil removal by-laws. Removing topsoil can negatively affect existing vegetation, storm water run-off and natural drainage, and erosion of remaining surface and subsoil.	Design a site plan that will respect existing site conditions. Incorporate temporary topsoil storage on site.
	SUNLIGHT AND SHADOWING Building orientation, bulk, height and size can affect the amount of sunlight received by neighbouring properties. The building design should conform to existing and adjacent site conditions.	Municipal regulations may require a sun/shadowing analysis. Architectural firms can provide modelling to examine the effects of the proposed structures on solar access and shadowing.
	DESIGN CONTROLS Design should conform to or reflect the surrounding landscape and natural environment. Design controls should include proper siting and orientation to make efficient use of solar energy and shadowing.	Design controls can be incorporated into the legal documents for the development.
	LANDSCAPING Consideration the existing landscape as it will have an impact on the design of the project. Some trees may be designated for preservation and existing contours may be incorporated into design controls. Site drainage may be incorporated into final landscape design. The landscaping should relate to the surrounding area.	Municipalities may have landscaping controls and require tree planting. They may provide boulevard trees for the development. Avoid damage to existing trees and protect root systems during from excavation.
	BUILDING DIMENSIONS Using standard or modular dimensions will minimize waste. Odd dimensions will increase the amount of wood and drywall waste generated.	Design ceiling heights and floor areas etc. which conform to standard material dimensions
	CONSTRUCTION PRACTICE	Focus on implementing the "three R's" Reduce - Reuse - Recycle.
	SOLID WASTE MANAGEMENT The production of waste materials is unavoidable in construction. However, there are significant pressures to minimize the volume of waste going to landfill sites.	On-site construction practices require modification to incorporate waste minimization, including reduced packaging, using prefabricated components, and incorporating on-site recycling.
	EXCAVATIONS AND GRADING Some excavations can damage the site, affecting topsoil, existing trees and vegetation.	Consider careful management of excavated topsoil, on site storage, protection and reuse. Waste products should not be ploughed into final grading.
	CARDBOARD & PAPER Cardboard accounts for 10% - 14% of construction waste. Much of it is due to packaging every thing from nails to furnaces to shingles.	Recycle by separating cardboard and paper from the waste stream. Most clean corrugated cardboard and paper can be recycled into carpet roll cores, or new boxes, etc. Reduce the volume by specifying on the purchase order that suppliers deliver goods with minimum packaging.

	DRYWALL Drywall waste can generate as much as 5 kg of waste for each square metre of finished floor area. Even though the drywall trades are generally responsible for their own waste removal, most of in ends up in landfills (or a back road ditch).	Reduce the volume of waste by designing floors and walls to optimize the use of full sheets. Order sheets to best fit the room sizes. Recycle drywall waste through local gypsum wall board recycling plants now active in many areas. Most landfills will NOT accept drywall waste.
	MASONRY/CONCRETE Masonry and tile can account for 12% of construction waste and 13% of demolition waste. concrete accounts for up to 53% of demolition waste. Ploughing masonry and concrete rubble into the ground is being strongly discouraged or banned.	Residual concrete from forming is often needlessly wasted, as it can be used for retaining walls etc. if dumped into quick makeshift forms. Reuse starts with effective daily site cleanup and sorting masonry and concrete materials into separate piles or bins. Excess brick can be used as part of chimneys or fireplaces on the next project.
	LUMBER Lumber represents the largest component of the waste generated on site. Off-cuts, warped lumber, discarded pallets, forming lumber, etc. contribute approximately 25% of site generated construction waste. Cost savings can be realized when the cost of solid waste disposal is considered.	Reducing the amount of lumber used on site is the first step. * Incorporate Advanced Framing techniques. * Design floor plans and elevations to optimize sheathing and sub flooring * accurately estimate and order materials * order precut studs and joists. A 10% waste allowance can be the difference between winning and losing the bid! Reusing lumber can reduce the total quality of material required, especially in larger renovation projects. Off-cuts can be used for bridging, backing or back framing, pallets can be torn apart for forming stakes, improved storage and inventory can allow material to move from one site to the next more easily. Recycling wood products requires sorting the waste products into separate bins and shipping to recycle.
	METAL & APPLIANCES Metals are the easiest waste stream product to sort and recycle.	Reduce metal waste by requiring sub trades to remove their own waste. Careful layout of ducting can affect the volume of metal used and scrap produced. Reuse is especially applicable to appliances from renovation projects. Contact salvage yards or used building product yards. Recycle metal through scrap dealers.
	PLASTICS & VINYL Plastics are a growing problem and the usage is increasing. They are not biodegradable and often turn up in landscaping many years after the house has been occupied. Packaging materials contribute to plastic disposal.	Plastics are made of a wide variety of substances that are often not chemically compatible. Many products now use recycled plastics for garbage bags, plastic dimensional lumber for decks, signage or compost boxes, etc. Plastic waste destined for recycling must be CLEAN or the load will be spoiled. Contact local recycling organizations.
	SHINGLES Asphalt shingles contributes about 6% of the volume of construction waste. There may be restrictions on disposal.	Contact local recyclers or Public Works departments. Reduce the volume of waste by more efficient use of materials.
	INSULATION Insulation is a common and bulky addition to the waste stream. Batts, rigid board, and foundation insulation contribute about 5% - 9% of construction waste.	Excess insulation is a contradiction in terms. Reuse of all insulation should be the norm. Scrap fibreglass can be used in attics, rigid and semi-rigid placed in partition walls for soundproofing. Recycling of clean foam insulation is being incorporated into the construction sites in some areas.
	PAINTS, SOLVENTS & SEALANTS These wastes are all classified as "Hazardous" and must be disposed of properly. Improper disposal can damage soil and ground water both at the site and in the land fill. 'Proper' disposal of hazardous waste implies an excess supply has been purchased and poorly used.	Reduce waste through bulk ordering and better inventory and storage. Reuse leftover paint as primer coats for other jobs. Solvents and paint thinners can be salvaged by letting the solids settle out and reuse the clear liquid. Recycle paint through facilities which are showing up tin the larger metropolitan areas. Recovered paints are converted into material that meet or exceed existing paint products.
	WASTE AUDIT Take an inventory of the waste generated on site.	Waste disposal companies may have custom designed bins for waste separation. Contact local recycling companies to determine what kinds of waste can be recycled in your area. Careful waste stream management may be able to pay the waged from savings in dumping fees!

A Resource & Contact List includes addresses for the following agencies. These are local to B.C., however, their counterpart exist in all other parts of the country.

- Ministry of Environment
- Ministry of Agriculture, Fisheries and Food
- Municipalities and Regional Districts
- Health Units
- Recycling Hot Line
- Canada Mortgage and Housing Corporation - CMHC produces a wide number of documents and reports on Construction Waste and the Environment.
- Local non-profit Recycling Councils or Associations
- Municipal Recycling Programs

The Checklist includes a section on site evaluation, as well as a sample waste audit form.

Builders' Environmental Check List was produced by: The Canadian Home Builders' Association of British Columbia. Copies are available for a $2.50 handling charge from:
CHBA-BC, Housing Industry Training Centre, 3700 Willingdon Ave., Burnaby, B.C. V5G 3H2
Tel: 604-432-7112
Fax 604-432-9038

Building Green

So you want to do the right thing and use environmently friendly products. You want to use resource efficient materials and products with recycled content. But where do you find the information? How do you know that a given product is better than its competitor?

In the last issue we reviewed *Environmental by Design* a source book of environmentally aware material choices. That book is a valuable starting point for manufacturers and suppliers from all parts of North America. However, few manufacturers will be manufacturing "green" products exclusively, so you still need to look for the appropriate information. Suitable labelling is needed.

For this reason, the **Build Green** program in Toronto is being developed. This is a joint initiative of the Greater Toronto Home Builders' Association and ORTECH International. The aim is to maximize the use of both renewable and recycled resources in new building products. Rubber tires, scrap plastic, glass bottles, newspaper and construction waste are some of the raw materials for new Build Green products. It is expected that the Build Green Logo will be a valuable a marketing tool for the suppliers, and a valuable identifying mark for buyers.

The objectives of the program are to:

- facilitate and initiate the development of new Build Green building materials from renewable or recycled resources.
- increase consumer and builder awareness of the wide range of Build Green materials.
- help the construction industry in Ontario achieve waste reduction targets of 50% in waste headed for disposal by the year 2000.

The Program is also intended to stimulate consumer driven demand for Build Green products, increase the diversion of construction waste from landfill sites, enhance existing construction waste recycling efforts, increase the viability of the blue box programs and divert waste from other streams.

Buy Green
Build Green
54% RECYCLED CONTENT BY WEIGHT
Registration number 2375
1-800-###-####
Building design mark of GTHBA. Other components marks of ORTECH. Build Green Label and component marks used under licence.

The Program relies on input and comments from an Advisory Committee that is comprised of industry, government and technical sponsors who are involved in construction waste diversion issues and Build Green products development.

Consumer Awareness Activities

In order to increase consumer awareness of the Build Green program, a series of displays have been developed. These include a "Green" Dream Home and a Build Green Street display at Toronto's 1993 National Home Show.

Standards

One of ORTECH's roles in the Build Green Program is to work with manufacturers to develop new products made from recycled materials and improve recycling processes. All Build Green products must be fully tested and meet applicable Canadian performance standards and codes. Indoor air quality issues are also of concern, so ORTECH is conducting a study to determine the off-gassing of Build Green Products compared to conventional building materials.

Build Green Label Program

Legal contracts have been developed to formally link manufacturers, builders, contractors and retailers to the Build Green Program through a common product label. The build Green Label offers participants the opportunity to become a part of an industry program to encourage the development and use of recycled content or renewable building products. The label allows knowledgeable and environmentally conscious consumers to identify these products and services. The Build Green Label will be available to manufacturers, wholesalers, retailers, and service providers within the building industry.

Build Green Material Resource Centre

Designers Walk at 168 Bedford Road (Toronto) is a resource centre and library aimed at interior designers, trades people and consumers interested in the latest home furnishing and building materials. This permanent display shows how construction waste and blue box recyclables are raw materials for new products.

Build Green Outreach Program

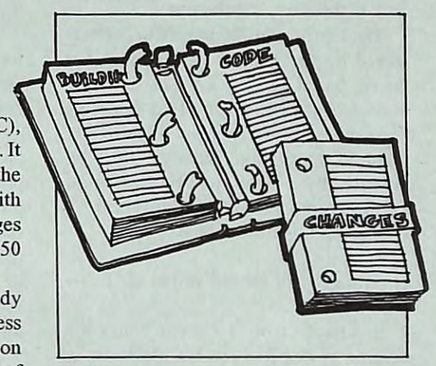
Anyone wishing to keep informed about the Build Green Program and its activities can do so by requesting a copy of the quarterly Build Green Newsletter.

Build Green products undergoing scrutiny include metal roofing, insulation, recycled plastic, recycled rubber products and wood products using recycled fibres of "waste" wood supply.

For information on the Build Green program:
Vera Fleischer,
Build Green Program
ORTECH International
2395 Speakman Drive
Mississauga, Ontario L5K 1B3

Build Green Hotline
Tel: 416-822-4111 Ext. 372
Fax: 416-823-1446

Proposed Code Changes



The National Building Code (NBC), is the model code used in all provinces. It undergoes a review every 5 years - the current revision cycle is underway, with the proposed 1995 NBC edition changes out for comment. There are over 250 proposed changes to Part 9 alone!

Few builders have the time to study the proposed changes in detail and assess their implications on house construction as there are so many of them. Because of the large number of changes CHBA commissioned a consultant to review them and highlight those that will have important cost implications. It is hoped that with this knowledge, builders will make their opinions known to code writers.

The object of the Code is to present minimum acceptable standards for the protection of the health and safety of building occupants. The code is not meant to set out quality standards or guidelines for what should be done, or what would be nice to achieve. When looking at some of these changes, it is worthwhile keeping this in mind.

Many of the changes are minor and will have little impact on how we build. However, six sections out of a total of thirty-five have been completely rewritten. Some of these incorporate changes with significant cost impacts. A few may lead to cost reductions.

The CHBA analysis has been documented in a report titled Proposed Code Changes - Our Chance to Be Heard. Copies have been circulated to all local associations.

We are highlighting some of the more significant changes here to give you an idea of what they are, and why they may have an impact on how you build in the future.

Mechanical Ventilation

We know that the traditional approach to ventilation of homes, allowing "natural" venting through air leakage, does not do an adequate job in modern buildings. Until recently code regulations have been minimal. It was assumed you just put in opening windows and that provided ventilation. But having lots of opening windows does not ensure satisfactory ventilation or indoor air quality.

Changes to code requirements in the past few years introduced performance based ventilation standards. However, that created too much confusion. When mechanical ventilation requirements were first introduced in 1985, B.C. redrafted the section, expanding it, making prescriptive compliance and inspection easier.

In the 1995 NBC, the ventilation section has been completely re-written. The proposed changes provide a prescriptive or performance option for ventilation system design. The performance path requires systems to comply with *CSA F326 "Residential Mechanical Ventilation Systems"*. The prescriptive requirements, while based on the CSA standard, tell you how to do it without having to study the CSA standard. Two basic prescriptive approaches are proposed, depending on the type of heating system

used: 1) for dwellings with forced warm air distribution systems, and 2) for dwellings without air distribution.

The size of ventilation system is determined by the number of rooms in the house, based on 10 L/s (21 cfm) for master bedroom, 5 L/s (10.5 cfm) for each other room. At least 50% of the required ventilation capacity must be provided by a better quality ventilation fan, the remainder can be provided by kitchen and bathroom fans.

Dwellings with forced warm air heating:

In houses with a ducted warm air heating system, where the fresh air is circulated by the furnace, a fresh air intake has to be provided on the return side of the furnace at least 10 ft (3 m) upstream of the furnace to allow for proper mixing. The principal exhaust fan must be interlocked with the furnace fan for simultaneous operation.

Houses without forced warm air heating:

The ventilation system must be fully distributed to provide fresh air to every bedroom and to each storey without bedrooms. Incoming air must be preheated, supply outlets must be located at or near the ceiling and a fresh air intake fan of the same capacity as the principal exhaust fan is also required, and must be interlocked for simultaneous operation.

As the principal exhaust fan is intended for continuous operation during winter months, this could result in additional energy expenditure if the system does not incorporate a heat recovery, especially if it is oversized.

To reduce the risk of depressurization in dwellings and the problems associated with backdrafting of combustion appliances, make-up air provisions are spelled out. Separate combustion air will no longer be required for fireplaces. Instead, carbon monoxide detectors must be installed and interconnected to smoke alarms in rooms with solid fuel burning appliances not equipped with doors that close off the fire chamber from the dwelling.

Maximum noise level requirements for fans and some ducts used only for ventilation may be made of lower cost combustible materials.

The proposed changes are quite comprehensive, but they go a long way to providing a workable prescriptive approach to ventilation. The most significant feature is the requirement for fully distributed ventilation systems. Because of the energy penalty, it will also make HRV's a fact of life in most houses - not just the very energy efficient ones.

The major problem with the proposed regulations as written is that they would not allow exhaust-only ventilation systems with supply air provided by passive inlets. These systems are currently on the market in Europe, parts of the USA and Canada. They are especially appropriate in milder climates and for some building types like apartments.

Air Barriers and Vapour Barriers

This section has been completely re-written and reorganized. The most significant changes may or may not be intentional. More clarification is needed as a lot depends on how the section will be administered.

For example, a new general requirement states that where any "sheet" material is used, having a "low air permeance" (moisture permeance of less than 60ng/Pa/s/m2) its use is restricted. Since many materials, including exterior grade plywood, foamed plastic, vinyl and metal sidings, and roofing materials are both air and vapour resistant when considered as individual units, this requirement could potentially have an impact on current construction practices. Much will depend on how big the pieces have to be before they are considered to be "sheets".

Vapour resistant sheet materials are permitted where they will not be below the dewpoint. There could be an issue of proper interpretation as to what is or is not acceptable. Where low permeance sheathing is used (such as plywood), and where there is a possibility that the construction could end up having a second vapour barrier on the cold side, then the vapour barrier (on the inside) has to have a much lower permeance (15 ng/Pa/s/m2).

Use of blown-in insulation in areas other than the ceiling will be permitted. This makes it clear that blown-in batt insulation systems are acceptable.

Air Barriers: The principle of air barrier continuity has been further defined to require that it extend across the ends of floors and walls where they intersect the building envelope. This will mean additional attention be to the continuity of the air barrier where each floor assembly meets the building envelope. While this is currently being done by R-2000 builders, it is not typical for many others.

Span Tables

A number of changes are proposed for the span tables for joists, rafters, beams and trusses. Some of the changes will fill gaps that currently exist. Others may result in a major upgrading from existing practice.

Floor Joist Span Tables:

A major change is the elimination of a span table for bedroom areas. At present this table allows lower design loads for bedrooms and increased deflection. The proposed change requires all floors to be designed to the same span table.

The second major change to the span tables is the inclusion of tables for "Special Cases". These apply to floor joists with gypsum board ceilings applied over strapping, and floor joists supporting a concrete topping. These tables all appear to allow substantially greater spans than existing tables.

Ridge Beam Span Tables

This is a new table. Roofs framed with conventional rafters are becoming less common, but are still being built. Under snow loads, rafters spread at the bottom and must be tied by means of ceiling joists, collar ties or the ridge beam must be supported. Current practice is to support the ridge with at least a 2x4 every 4 ft. and the ridge must be at least a 2x6.

This new item replaces the simple rule-of-thumb and conventional practice with a new table that specifies allowable spans between supports for different sizes of ridge beams, snow loads and different wood species. The size of ridge beam required varies from three 2x8's to five 2x12's. These ridge beam sizes are unheard of in traditional roof rafter construction.

While it may be useful to have a roof beam table for use with post and beam construction it may not be appropriate to apply such a table except when the present "rule-of-thumb" dimensions are exceeded. Unless there is adequate documentation to show that current practice has not been satisfactory, it is difficult to understand the need for such a change.

Lintels

Current lintel tables are based partly on rule-of-thumb practices and partly on theoretical calculations. For many years it has been known that tables for exterior wall lintels are theoretically undersized when analyzed by conventional engineering calculations. Changes have been resisted over the years on the basis of satisfactory field performance. The new lintel tables will require substantial upgrading of lintel sizes for exterior walls except in very low snow load regions. Sizes for interior lintels, however, are generally less restrictive, permitting longer spans than is currently the case. The proposed new lintel spans differentiate for both different wood species, snow loads, and supported length of joists or rafters.

Roof Trusses:

Formal recognition is now given to truss design procedures developed by the Truss Plate Institute of Canada. These procedures were apparently developed as a means of satisfying the performance requirements specified in the Code without the need for full scale tests. This proposed change should have little or no practical effect on construction practice, except to recognize a design procedure already being followed.

Guards for Windows

A new proposal will require windows with an opening section more than 15" (380mm) wide and a sill less than 8" (200mm) above the floor will have to be protected with a guard if the floor level is more than 2 ft (600mm) above the finished floor or grade level.

This means that a living room window with an opening section less than 8" to the floor would need to have a guard (with no openings more than 4" wide) - even if the grade level outside is only 2 feet below the floor.

Stairs, Handrails and Guards

A number of changes will affect stair design. One of the most important is a proposal to require that at least one handrail be continuous on stairs, including at landings. Currently, newel posts are permitted as an exception primarily because of their common usage. These appear to be creating no real difficulties for blind people, the original target for this requirement.

The proposed change would delete the reference to newel posts, thus preventing their use anywhere in a handrail system. This means that all those nice decorative railings you see in heritage homes would be non conforming now. (Has there really been that many accidents? Are they really that bad?)

Another stair design change would allow winders in stairs as long as there is no deviation above or below 30°. In other words, you can have as many winders as you want, as long as each one turns 30° precisely, no more and no less. (i.e. 45° winders are out!).

Stairs to basements in the past have been permitted to have one side open. This will no longer be allowed. As basements are more often being used as finished space, this seems to be an appropriate change.

Stairs within a dwelling will have to have risers at least 5" (125mm) in height and a treads with a maximum run of 14" (335mm). This is the same as is now required for public buildings. New requirements are also proposed for stair nosings - they will not be permitted to extend more than 1" (25mm) beyond the face of the risers.

Guard Height:

It is proposed to increase the minimum guard height on dwelling stairs by 100mm, making it the same as guards on public stairs. This proposed change could require stairs in many areas to be redesigned with higher banisters (or balustrades) resulting in increased costs.

Perhaps we should eliminate stairs all together then there won't be any problems - it would guarantee perfectly safe buildings!

We've presented highlights of a few of the proposed changes. If any of these have sparked a concern, we urge you do some follow up. Public comment is actively solicited on the proposed changes. Comments must be specific to the wording as proposed, and must provide reasons.

You can see the full report commenting on the proposed changes at your local Home Builders' Association or by contracting the TRC directly. To get a copy of the proposed NBC changes, contact:
National Research Council Canadian Commission on Building and Fire Codes
Tel: 613-993-9960
FAX 613-952-7673
(you must identify which part of the Proposed Code Changes you want to see. Part 9 has it's own book).

The last date for receipt of comments (at the National Research Council) is **Dec. 17, 1993.**

Technical Research Committee News

Canadian Home Builders' Association

Gas Service Standards

In most of Canada that is served by natural gas, the gas line provides clean burning fuel that is used to heat homes, fuel fireplaces, provide hot water, and increasingly is used for cooking in stoves as well as barbecues.

Gas is distributed in a high pressure line, which not unlike most municipal water services, is stepped down to a low pressure line serving the individual residence. As with any other potentially hazardous fuel, there are regulations that provide regulations covering installations. The Major Industrial Accidents Council, a national body concerned with major industrial incidents has recently drafted new guidelines for hazardous industrial sites. Among the recommendations is one that calls for a 200 foot development setback from high pressure gas lines (it used to 20 feet from the property line).

It seems that the proposed guidelines, which are for industrial sites, have created some confusion and may be applied to residential sites. The concern is that the misunderstanding could affect residential development. The city of Regina is holding up developments on account of a possible misreading of the guidelines.

It could be a case of not understanding the guidelines, or of some official being overly sensitive to the possibility that something may go wrong, so they go overboard. (We hope this won't become another sprinkler issue!) The TRC is monitoring this situation to prevent the situation getting out of hand. If you have had any problems relating to gas service standards, contact the TRC.

Sprinklers

Unfortunately, this is an issue that will not go away. The fire officials are continuing the pressure and emotional appeals on the decision makers, trying to have them made mandatory. It seems that fire departments have got caught up in the technology of sprinklers while the intent is to focus on life safety and prevention. CHBA's sprinkler kit is available to help anyone trying to provide reasoned information to decision makers about the issue.

Recently, the Penticton Home Builders were confronted with a drive by the local fire marshall for mandatory sprinklers, which was spurred on by the fire death of three people in an older apartment building. Following a presentation by home builders, City council listened and watered down the sprinkler regulations, (now only all multiple residential dwellings over two storeys must be sprinklered). In Alberta dialogue has started with fire officials to review the entire sprinkler issue and to clarify issues of concern.

Energy Codes

As we're reported in the past, a new national energy code is being prepared with the intention that it be incorporated in the basic building code. A draft version will be ready soon. A national energy code workshop is being planned at the same time as the next meeting of the TRC, which will be held in conjunction with CHBA's Annual convention in Banff. The workshop will review the requirements of the proposed energy code. This will offer you an chance to comment on the proposed standards.

The next TRC Meeting will take place Friday, Feb. 11, 1994 in Banff, and the half day national energy code workshop will take place Saturday, Feb. 12, 1994.

Ontario has already implemented energy standards in their revised building code. BC will be implementing changes early in 1994.

Carpet Staining

In Solplan Review No. 49 we reported on the problems that are becoming increasingly more common caused by the staining of carpets. The TRC is still trying to initiate a detailed investigation of the source of the problem and the best way to deal with it. If anyone has any specific experiences with the problem, you can contact the TRC directly and let them know.

If you've had luck with removing the stains, let them know too.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector. Membership includes builder members and representatives from industry, standards and governments bodies with an interest in housing. Anyone with a problem, technical question of suggestions for areas that need to be investigated is encouraged to contact their local Home Builder's Association technical committee or the TRC directly.
To contact the TRC:
Canadian Home Builders Association, Suite 200, 150 Laurier Ave. West, Ottawa, Ont. K1P 5J4

Tel: (613) 230-3060; Fax: (613) 232-8214

Drywall Staining

Drywall staining was a major problem a few years ago. After considerable research effort, the principal culprit was found to be a combination of light, hydrogen sulphide and water vapour, along with fungicide in joint compounds that contained mercury.

How Can Stains Be Repaired?

The best way to correct the problem is to seal the stained wall with a latex sealer, an alkyd-based paint or other paint with similar hiding characteristics (such as acrylic emulsion stain blockers). Flat latex paint cannot be used successfully to seal the wall.

If stains are intense, a bleach and water wash (5% by volume) and thorough rinsing is recommended prior to sealing. The sealing coat must be allowed to dry thoroughly before the final coat is applied.

In rooms where humidity and moisture condensation are not common, a final coat of latex paint can be used to give the desired finish. In bathrooms, kitchens and other rooms where high levels of humidity may be a problem, the final coat should be of a product with low permeability, such as alkyd paint.

The study findings are summarized in a new booklet "Drywall Staining Project: Findings and Solutions", published by CMHC.
For a copy contact CMHC directly (613-748-2367) or the TRC.

Letter to the Editor

Sir,

Re letter to the editor responding to my letter contained in the April-May 1993 issue (No. 50) of Solplan Review. (re: Hard Ducted Make-Up Air for Ventilation, Solplan Review No. 47).

1. I agree with Mr. Geddes; what was relevant at the time when the study was undertaken was no longer relevant by the time the article appeared in Solplan Review.

2. Mr. Geddes did not reply to the question of continuous versus intermittent fan operation. Continuously operating fans may more critical than intermittently operating fans (call for heat only).

3. The study involved 2-year old houses, and was carried out in spring of 1991. In 10% of all furnaces shipped in 1988 were "mid-efficiency" furnaces. So there must have been some available for observation.

4. His statement that the 15.5°C return air temperature was not documented until 1992 is incorrect. He documented it, in his own paper in 1991. Failure to include this issue is glaring error.

5. The study did not state the type of furnace in the test. (standard or mid-efficiency).

6. The terms of reference of the study may well have referred to the "rusting of conventional gas furnace heat exchangers due to the condensation of water vapour contained in basement air", but the issue is the condensation of water vapour (and acidic impurities) in the products of combustion inside the heat exchanger.

7. One of the objectives of the study was to find: "What is the minimum distance for the connection of the fresh air duct to the return air to ensure proper mixing of the two air streams." No actual temperature measurements were made between the connection point of the outdoor air duct and the furnace. How it is possible to respond to the stated objective when there was no assessment of whether or not the air was actually well mixed?

8. To refer to the use of electric induct heaters without noting the safety concerns associated with their use is glib or irresponsible. At the time that the report was prepared, there were no heaters certified for this use.

9. Page 29 of Mr. Geddes' report states: "Despite the extensive training sessions provided to contractors by HRAI, a visit to many houses being built in accordance with the Ontario Building Code indicates that some designers and installers have little or no understanding of basic physics, air movement or ventilation. Better and more practical training courses delivered by knowledgeable trainers may help."

I am pleased that he has clarified what he meant by this statement, that is ; "Although there are training courses extensively available, not many contractors take them". I agree with him although to be fair, many Contractors have taken the time to attend courses. There are well over 1,000 HRAI certified ventilation installers in Canada. His letter of reply says that he did not intend to criticize HRAI courses, and I appreciate the retraction.

His letter notes that only a small number of heating contractors are HRAI members. This statement implies that HRAI training is available only to members, which is not the case. In fact, HRAI courses are available in all provinces and territories, and are popular with builders and building officials, as well as other non-members.

10. The HRAI ventilation courses have included information on how to meet the requirements of the NBC, 1990 since October of 1989. The OBC 1990 requirements are identical to the requirements of the NBC/90. Mr. Geddes states that; "The courses available at the time of report writing were not, in my judgement, and borne out by the installations I examined, broad enough nor intended to deal adequately with other methods of meeting the requirements of provincial building codes, as applied to regular

houses." As Mr. Geddes has not attended an HRAI ventilation course since 1989, it is difficult for him to make a judgement of this nature.

11. In his reply, Mr. Geddes states that he did not intend to criticize HRAI or it's instructors. I appreciate Mr Geddes' clarification of this point.

12. When discussing the matter of training and the accessibility, content, and instructors qualifications, it should be noted that these subjects are completely beyond the scope of the work carried out by Mr. Geddes for this study.

13. In Ontario since 1990, there has been much confusion about residential ventilation. A lot of this confusion was caused by the CMHC-ONHWP publication "How to Comply with the Ventilation Requirements of the OBC 1990". The Ontario New Home Warranty Program also delivered a seminar called "Speaking in Code", which gave information on the 1990 OBC requirements, including ventilation. At these sessions, and in the publication, there was no mention of the advisability of, nor the availability of additional training in ventilation, although such training was readily available at the time from HRAI. The result is that although training may have been appropriate, it was not encouraged by those who were in a position to promote such training.

The situations that Mr. Geddes reports as deplorable would be ridiculous if they were not true. Many of these situations can, however be attributed to the NBC itself which recommended the large "holes in the wall" as well as electric make-up air heaters.

14. Mr. Geddes points out that connecting of an outdoor air duct to a forced air system requires that the entire system be designed according to "good engineering practice" (required in part 6 of the NBC). As an industry, this is something that we should be taking more to heart. An outdoor air connection to the return air duct is not something that you can "just hook up".

15 In his reply, Mr. Geddes states that he found my first letter "Unnecessarily defensive, unprofessional, containing many inaccuracies and largely nit-picking at a competitor." I have not found any inaccuracies in my original letter, other than a misunderstanding about the source and timeliness of the material. I do not consider Mr. Geddes to be a competitor. I did not write the letter to nit-pick but rather, out of professional concern that your readers might be mislead by the content of the article. Readers unfamiliar with the issues might easily conclude (incorrectly) from reading the article that:

a. Connection of outdoor air ducts to return air ducts cannot be found to cause increased heat exchanger corrosion in furnaces.

b. An acceptable design mixed-air temperature for the design of a forced-warm air heating system is 13°C.

c. Electric duct heaters are a practical means for heating incoming air to an acceptable temperature and although operating costs are high, may be preferable to an HRV because of the high capital costs of an HRV.

d. Courses in this area offered by HRAI do not adequately cover requirements and need to be improved.

16. Mr. Geddes points out that I criticize the project manager(s) and others who worked on the project. Perhaps he is suggesting that I should refrain from criticizing this work because it is embarrassing to those people. I believe that in the building science sector in particular, there is too little critical review of this type of work. If there is no criticism, then the inevitable result is unchallenged acceptance of inconclusive work like this study. As professionals we should be concerned when the precious little monies available for research in the building science sector are spent on projects such as this which have, effectively; no result.

If any of the persons who participated in the study would like to discuss the error of my observations concerning the content and conclusions of the study, I would by happy to do so with them. On the other hand, when of misleading information appears, it is sad to think that some people believe that it is inappropriate to criticise it, because of whom one might offend. Is this professionalism?

Dara Bowser
Brantford, Ontario

Green Home:
Planning and Building the Environmentally Advanced House

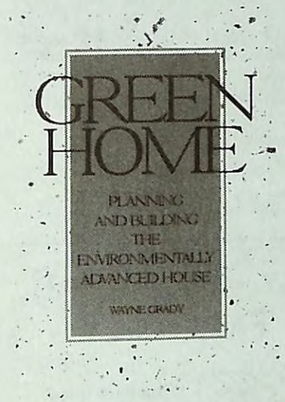
The process of designing a demonstration home involves many challenges. When the home is at the cutting edge in energy efficiency and environmental responsibility the challenge is even greater.

The team behind the Waterloo Green Home focused on the environmental issues. They had Wayne Grady eavesdrop throughout the design and construction phase to document the process. The result is a well written book that's a good read.

While the end result, the house, is interesting, more important is the process by which decisions are made - what where the compromises made and why. The Green Home lays out not only the planning and construction process, but also provides an excellent background to the global energy picture today, how we got where we are today and why energy conservation is still an important consideration.

The active solar installations of the late 1970's (anyone remember the large rooftop solar collectors that were going to solve the energy problem?) through to the realization that energy conservation and optimization of passive solar energy is the best way to heat buildings is well documented.

We were especially fascinated by the explanation of the "energy audit" that looked at the embodied energy content of materials. The energy cost of every material or system proposed, from raw materials to transport to the job site, to the life cycle of the product was calculated. This is a concept that is increasingly being considered, as it provides a better picture of the impact of the materials we use. Just because you don't see the environmental damage, doesn't mean it's not there.



What is second nature for those designing and building energy efficient construction is still quite foreign or a non-issue for others. This book goes a long way to explaining why these concerns are critical for our survival on this planet and it's done without getting into technical jargon.

Unfortunately, the book did not receive the technical review it deserved, so that too many errors slipped by. Some are minor (such as reference to OPEC as OAPEC) others very glaring (in the context of ozone depleting substances the author completely misunderstood the terms and kept referring to R22 as the insulation value, while he was talking about a refrigerant gas that used to be used as a foaming agent in rigid foam insulation products).

So you shouldn't count on all the numbers and technical facts being correct. However, as a general introduction to the latest direction that the Advanced Houses are pointing to, this is a must read book.

Green Home: Planning and Building the Environmentally Advanced House by Wayne Grady. $15.95 Published by Camden House Books available at most bookstores or from Harrowsmith Magazine

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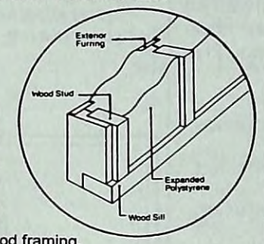

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FABRICATORS ACROSS CANADA

CCMC evaluation Report No. 09589

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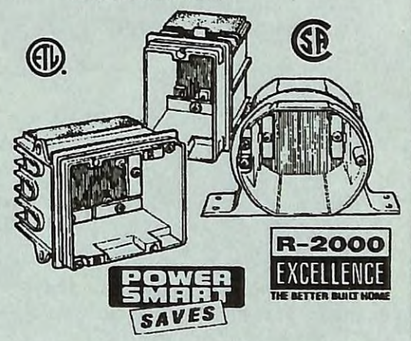

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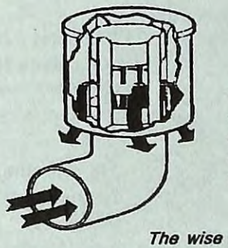

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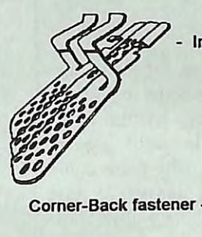

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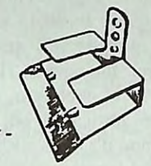

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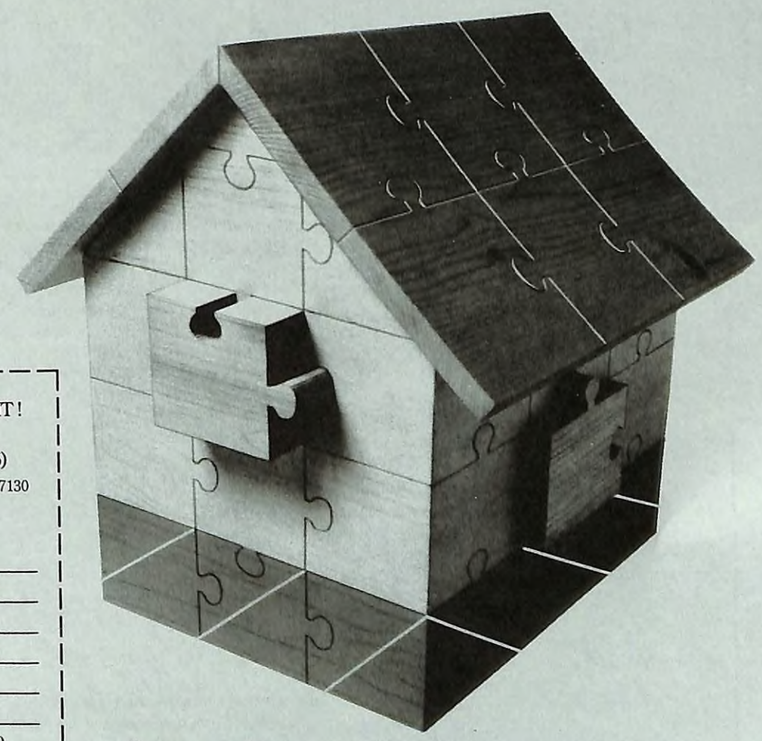

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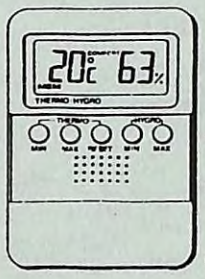

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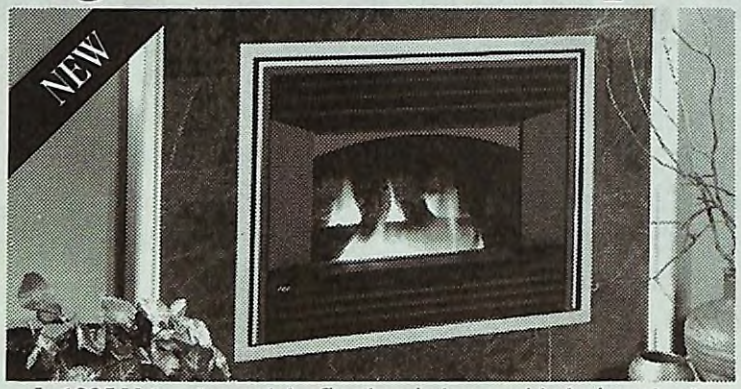

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